**Stress Scale in the Context of Online Learning among Junior High School Students (ages 11-17): Development, Validity, and Reliability**

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**Abstract**

The COVID-19 pandemic has prompted an unprecedented shift from face-to-face to online learning. Considering the impact of this transition, the researchers developed a scale measuring the stress levels of 319 junior high school students. Based on the evaluation of experts, the item content validity index (I-CVI) proved the validity of each item. From the original 32, 20 items were retained after conducting exploratory factor analysis (EFA). A new clustering was derived from the results, namely: (1) physical health, (2) task management, (3) valuing, and (4) relating to oneself and others. The final 20-item scale was proven to have internal consistency among items with Cronbach’s alpha of 0.923. The results of measurement invariance (MI) tests indicate that the newly developed four-factor stress scale in the context of online learning measure the same underlying constructs across sex, grade level, and age groups. Consequently, the differences in stress levels among the groups were also determined.

**Keywords:** *stress, validity, reliability, scale development, measurement invariance, online learning, junior high school*

1. **INTRODUCTION**

Due to the COVID-19 pandemic, schools have resorted to online distance education. Many researchers investigated how the current circumstances have negatively affected students. Based on recent studies conducted in various countries, university students have shown a significant increase in levels of stress especially at the onset of the pandemic (AlAteeq et al., 2020; Cao et al., 2020; Chandra, 2020; Chen et al., 2020; Dwivedi, 2020; Fawaz & Samaha, 2020; Kecojevic et al., 2020; Moawad, 2020; Rodriguez-Hidalgo et al., 2020; Son et al., 2020; Zurlo et al, 2020). High levels of stress, if not managed properly, could result in problematic behaviors, mental health issues, and poor academic performance (Pascoe et al., 2019).

Most studies have been devoted to understanding the impact of the pandemic among university students. Less attention has been paid to those in secondary education. It is important to note that high school students are in their adolescent years which means that they may be less capable of managing stress because of the many developmental changes happening to them (Veyis et al., 2019). According to the World Health Organization (2020), the rapid growth adolescents are experiencing has a significant effect on their feelings, ways of thinking, decision making, and interpersonal relationships. It is crucial, therefore, for parents, teachers, and administrators to make data-driven decisions in responding to stress-related concerns of adolescents. Leonard et al. (2015) observed that adolescents, particularly those in private high schools are an understudied population when it comes to this topic. Thus, researchers wanted to develop an empirically validated scale measuring levels of stress among adolescents especially in this time of the pandemic. The study aims to develop a valid and reliable scale that will be used to measure junior high school students’ stress levels in the context of online learning.

*School-related stress among adolescents*

Adolescents spend approximately six hours a day for 200 days in school during the most crucial years of their physical, social, and cognitive development. Potential causes of school stress include exams, heavy workload, involvement in extracurricular activities, unrealistic expectations coming from parents and teachers, and poor relationships with peers (Veyis et al., 2019). Adolescents have to deal with all of these while they cope with the changes happening to them.

Studies have shown that there is a direct relationship between school stress and other variables such as mental health problems like depression and anxiety, disruption to sleep quality and quantity, and risky behaviors like drug use (Leonard et al., 2015; Pascoe et al., 2019). Anything that compromises students’ well-being could hinder them from attaining desired learning outcomes. According to WHO (1996), good health and emotional security are essential for students to be actively involved in the learning process. It comes as no surprise how high levels of stress not only affect overall health but also impede academic success (Sohail, 2013; Pascoe et al., 2019). The long-term consequences of stress can be even more detrimental to adolescents. When exposed to distressing experiences, they may suffer from psychological problems later in life (Bolton et al., 2000).

*Stress scales*

There are readily available self-report instruments that could be used to gather data on stress. One of the most widely used scales on stress is the Perceived Stress Scale (PSS) by Cohen, Kamarck, and Mermelstein (1983). The scale has a total of fourteen items that ask about how respondents thought or felt towards stressful situations. This instrument was proven to be valid because higher scores were linked to the inability of individuals to stop their smoking habit and to their considerable distress in social situations among others (Cohen, Kamarck, & Mermelstein, 1983). Using the PSS, AlAteeq, AlJhani, and AlEesa (2020) investigated the levels of stress among university students upon the implementation of online learning. They found that students from the Kingdom of Saudi Arabia had moderate to high stress levels at the onset of the pandemic. Cohen and Williamson (1988) developed a shorter version of the PSS by taking out four items that had the lowest factor loading scores resulting in a ten-item scale. The PSS-10 showed better psychometric properties than the original instrument (Baik et al., 2019). Son et al. (2020) utilized the PSS-10 to look at the stress levels of college students during the COVID-19 pandemic. They found that the majority of the respondents reported increased levels of stress and anxiety.

There are instruments that have been developed to measure academic stress. One is the Educational Stress Scale for Adolescents (ESSA) by Sun et al. (2011). This instrument consists of 16 items and the following variables are considered: pressure from study, workload, worry about grades, self-expectation, and despondency. Reliability and validity tests revealed acceptable to satisfactory results. Somewhat similar to the PSS is the Perception of Academic Stress Scale (PASS), an 18-item scale that evaluates perceived academic stress among students in the undergraduate and graduate levels (Bedewy & Gabriel, 2015). The scale consists of items related to academic expectations, workload and assessments, and academic self-perceptions. The instrument is reported to have a fair internal consistency. The analysis yielded four factors that are correlated with each other.

Moreover, some tools were specifically developed to measure stress brought about by COVID-19. Aiyer et al. (2020) came up with the COVID-19 Anxiety and Stress Survey (CASS) by taking some items from two already existing instruments–the Perceived Stress Scale and the Patient Health Questionnaire for Depression and Anxiety. The survey was used to determine the level of anxiety and stress among high school and college students due to the continuous rise in cases. In Zurlo et al.’s (2020) study, the COVID-19 Student Stress Questionnaire (CSSQ) was constructed to assess the stressors brought about by the pandemic among students in tertiary education. There are three subscales in this survey that measure sources of stress related to the following: relationships and academic life, isolation, and fear of contagion. The CSSQ was proven to have satisfactory internal consistency after computing for the inter-item correlation, Cronbach’s alpha, and McDonald’s omega.

*Online learning and stress*

What makes this change in the mode of learning delivery significant in the study of stress? Online learning poses a whole new challenge for students. According to Shahsavarani, Ashayeri, Lotfian, and Sattari (2013), stress arises when there is a huge change in the environment that disrupts an individual’s homeostasis. As a result of long periods of isolation, there has been an apparent loss of motivation, meaning, and self-worth among individuals (Williams et al., 2020). According to Hans Selye, father of stress research, stress is the “nonspecific response of the body to any demand” (1976, p.15). Major sources of stress in online learning include workload, time for synchronous classes, a home environment that is not conducive to learning, the use of online platforms, and uncertainty about the new learning setup (Moawad, 2020). With studying taking place at home, parents may set higher expectations from their children and this could result in higher levels of stress.

Shahsavarani, Abadi, and Kalkhoran (2015) conducted a systematic review of various studies on stress and were able to identify eleven major definitions that looked at the consequences of environmental demands upon individuals. Lazarus (as cited in Robinson, 2018, p. 7) noted how responses to stress could be classified into four categories: “(a) disturbed affect, (b) motor behavioral reactions, (c) change in cognitive functioning, and (d) physiological changes”. The researchers attempted to put these domains together into a single scale.

*Cognitive, Behavioral, Affective, and Physiological Domains*

Based on different reviews, studies, and meta-analyses, Shields (2020) enumerated some of the well-known consequences of stressors on human cognition such as difficulty in retrieving information from short-term and long-term memory, struggling to avoid distractions, and being hasty in making decisions (Shields, 2020). Changes in cognitive functioning may be evident if an individual worries constantly, has racing thoughts, becomes forgetful and disorganized, and only looks at the negative side of things (Dua, 2019). When an individual is exposed to too much external pressure, he may show apparent changes in behavior. Accounting for several studies and literature reviews, Dua (2019) was able to specifically enumerate the most common behavioral symptoms of stress. They are changes in appetite, tendency to cram and avoid one’s responsibilities, substance use, and abuse, and display of nervous behaviors like biting nails, moving restlessly, and pacing (Dua, 2019).

Emotional intelligence pertains to a person’s knowledge of self and others, ability to manage oneself and others, and ability to motivate oneself and others (Gujral, 2013). It helps an individual cope with environmental demands. However, students who are stressed tend to have difficulty dealing with others and lose the motivation to perform well in school (Humensky, et al., 2010). Consequences of disturbed affect include low self-awareness, poor self-regulation, and poor emotional literacy. Excessive demands could also affect students’ bodily functions. Pascoe et al. (2019) found that academic-related stress caused individuals to develop serious health issues primarily because of the lack of exercise and the cultivation of harmful habits. Yaribeygi et al. (2017) explained how stressors may compromise various physiological systems of the body such as the immune system, cardiovascular system, and digestive system. A person who is stressed may exhibit the following symptoms: low energy, diarrhea, muscle pains, increase in heart rate, insomnia, and frequent colds and infection (Dua, 2019). In addition, Martin (2016) discussed the link between stress and headaches. This is one symptom commonly experienced by individuals when they are under extreme pressure.

As the COVID-19 pandemic continues to unfold, educational institutions should initiate courses of action that would help students adjust to the new learning setup and promote their overall health. Data about stress is important to achieve health and educational gains (Gross, 2014). Said data will be used to provide evidence-based interventions. Examples of these are programs that develop students’ stress management and coping skills (Kraag et al., 2006). Prioritizing students’ health above all else especially in this time of a global health emergency will have significant educational returns in the long run.

1. **METHODOLOGY**

**A. Scale development, research participants, and data collection**

The researchers developed original items for the questionnaire based on existing literature on stress levels. The first part contains demographic questions while the second part consists of items that would measure students’ stress levels in the online learning setup. These items fell under the cognitive, behavioral, affective, and physiological domains. Each domain was composed of eight statements that would be ranked on a 5-point Likert scale ranging from 1 (never) to 5 (always). The items were pretested among 20 junior high school students. The researchers opted to use purposive sampling because participants had to be students in junior high school who are currently enrolled in an online learning setup for the academic year 2020-2021. A total of 319 students participated in the study.

**B. Establishing validity and reliability**

The researchers investigated the existing and most recent literature on the most common themes in studying stress. Four domains were used to group the items, which are all backed up by the premises of the studies. The domains are (1) cognitive, (2) affective, (3) behavioral, and (4) physiological. The researchers asked five (5) field experts to evaluate the thirty-two (32) items (eight items for each domain) based on their relevance to the domain of interest. Each expert was asked to give comments on the items and to assess each item through a Likert Scale with the following choices: (1) not relevant, (2) somewhat relevant, (3) quite relevant, and (4) highly relevant.

To quantitatively determine the degree to which an instrument sufficiently and appropriately includes the items for the construct being measured, content validity is utilized. Specifically, the statistic involved is called Content Validity Index (CVI), of which there are two kinds: item content validity index (I-CVI) and scale content validity index (S-CVI). For this study, I-CVI was utilized. For each item, the proportion of those who gave (3) quite relevant and (4) highly relevant over those who gave (1) not relevant and (2) somewhat relevant was determined. This means the value of I-CVI ranges from 0 to 1. A scale with excellent content validity is composed of I-CVIs of 0.78 or higher (Shi, et al., 2012).

To measure the reliability or internal consistency of the scale, Cronbach’s alpha was utilized. For each item on a scale, there are two variances that can be computed: the variance within the item and the covariance between a particular item and any other item on the scale. The values may range from zero (0) to one (1). The often interpretation of this measure of reliability is that a value of 0.7 or 0.8 is acceptable (Field, 2009).

**C. Conducting exploratory factor analysis**

With the goal of identifying the domains or variables that could explain the construct of interest, which is stress level, the researchers subjected the responses to exploratory factor analysis (EFA). However, before conducting EFA, Kaiser–Meyer–Olkin (KMO) measure shall be used for sampling adequacy. The KMO measure is equivalent to the squared correlation between variables to the squared partial correlation between variables. This statistic ranges from zero (0) to one (1). Kaiser (1974), as cited in Field (2009) recommends that values lower than 0.5 means either collecting more data or rethinking of the variables to include.

The differences or similarities of the variances among the treatment groups were also determined. Values closer to one (1) mean more homogenous variances among treatment groups (Arsham & Lovric, 2011). The exploratory factor analysis (EFA) attempts to determine if there are hypothetical constructs or factors of the smallest number that can explain the covariation among the measured variables (Watkins, 2018). A factor, as described by Brown (2015) as cited in Watkins (2018) is *“…an unobservable variable that influences more than one observed measure and that accounts for the correlations among these observed measures (p. 10*).” This was the first time that the scale was used, so this context required exploratory factor analysis.

**D. Establishing measurement invariance**

The data using the newly developed stress scale need to undergo measurement invariance to ascertain that the construct being measured by the scale is applicable to different groups and to ensure that group comparisons are valid. Measurement invariance tests were conducted across sex, grade level, and age groups of respondents. Invariance refers to the requirement that quantitatively measured constructs have the same meaning across different groups, and that group differences of sample estimates such as means reflect true differences, not from group-specific characteristics that are not related to the construct of interest.

The multi-group confirmatory factor analysis (MG-CFA) framework allows invariance testing in a sequence of increasingly strict invariance. Dimensional (baseline) invariance is the most basic form of invariance, in which the same number of factors can be found in all groups, regardless of the underlying item and factor configuration. Configural invariance is the most frequently tested type of invariance, in which it is determined if the same factors are associated with the same items in all groups. Configural invariance is inadequate to defend quantitative comparisons between groups because factor-intercorrelations and factor weights per item will vary across groups (Gregorich, 2006, as cited in Strijbos, Pat-El, & Narciss, 2021).

The next level of invariance is metric invariance (also known as weak-factorial invariance), which examines whether (common) factors have the same meaning across groups – expressed as equal factor loadings. Scalar invariance (also known as strong-factorial invariance) is the first level of invariance that is sufficient to defend quantitative group comparisons when factor-loadings and factor intercorrelations are equal across groups (meaning that common factors have the same meaning across groups) and there is no differential response bias between groups. Scalar invariance allows for accurate population comparisons because (1) group variations in predicted factor means are specifically attributable to group differences in factor means and are not contaminated by differential additive response bias. Finally, strict factorial invariance (also known as residual invariance) is the most restrictive type of invariance, in which item-residuals are equal across populations. This would allow researchers to compare not only the means of different groups, but also their variance estimates (Gregorich, 2006, as cited in Strijbos, et al., 2021).

As recommended by most scholars, reporting of fit statistics included chi-square (x2) and at least two alternative fit indices (AFI), namely, Standardized Root Mean-square Residual (SRMR) and Root Mean-square Residual (SRMR). Measurement invariance is established when at least 2 of 3 fit statistics proved acceptance of model equivalence: non-significance of chi-square (x2) p-value means good fit; SRMR ≤ 0.08 = good fit; Change in SRMR ≤ .030 for metric and ≤ .015 for scalar or residual = good fit; RMSEA ≤ 0.05 = very good fit and ≤ 0.06 and ≤ 0.08 = good fit; and Change in RMSEA ≤ .015 = good fit (Putnick & Bornstein, 2016).

1. **RESULTS AND DISCUSSION**

**A. Content validity index (CVI) from the evaluation of the field experts**

The data gathered from the solicitation of evaluation from the experts were used to determine the Content Validity Index (CVI) of each of the thirty-two (32) items. According to Rodrigues et al. (2017), the well-accepted value of the CVI by the research community is 0.80 to 1.00. Following this cutoff, ten (10) of the items will be eliminated—five (5) from the cognitive domain and five (5), as well, from the affective domain. Rather than pushing through with elimination, the researchers decided to keep the items because most of the evaluations were contradictory. In some items, one or few of the evaluators regarded an item to be highly relevant while the others considered them as not relevant. Instead of completely discarding the items, overall and major revisions were made to the format of the items.

**B. Pretesting of the items**

After soliciting the experts’ evaluations and adopting their recommendations, a pretest was conducted among twenty (20) students—five (5) from each junior high school grades levels 7, 8, 9, and 10. After answering the items, the students were also asked to give their comments on the items. The facilitators were also asked the questions raised during the answering of the questionnaire. Based on the list of the comments, the students found the items easy to understand. There were just some instances where some students asked what the word *“cramming”* meant. This has been duly addressed and necessary tweaking was done.

**C. Demographics of the research respondents**

The questionnaire was administered to 319 respondents, which were composed of 151 males (47.3%) and 168 females (52.7%). The respondents were in Grade 7 (n=73, 22.9%), Grade 8 (n=86, 27.0%), Grade 9 (n=83, 26.0%), and Grade 10 (n=77, 24.1%). In terms of the age of the respondents, the data ranged from eleven years old (11) to seventeen years old (17) with an average age of 13.9. In the analysis conducted, the means of stress level were based on age groups: 11-12, 13-14, and 15-17. Table 1 displays the frequency distribution of respondents by demographic variables.

**Table 1.** Demographic frequencies and SPSS value assignments

|  |  |  |  |
| --- | --- | --- | --- |
| **Demographics** | **Assignment of Values in SPSS** | **Frequencies** | **Percentages (%)** |
| **Sex:** |  |  |  |
| Male | (1) | 151 | 47.3 |
| Female | (2) | 168 | 52.7 |
| **Grade Level:** |  |  |  |
| 7 | (1) | 73 | 22.9 |
| 8 | (2) | 86 | 27.0 |
| 9 | (3) | 83 | 26.0 |
| 10 | (4) | 77 | 24.1 |
| **Age:** |  |  |  |
| 11 | (1) | 3 | 0.9 |
| 12 | 56 | 17.6 |
| 13 | (2) | 78 | 24.5 |
| 14 | 65 | 20.4 |
| 15 | (3) | 78 | 24.5 |
| 16 |  | 35 | 11.0 |
| 17 |  | 4 | 1.3 |

**D. Kaiser-Meyer-Olkin test, Bartlett’s test, and exploratory factor analysis (EFA)**

At the start, there were 32 questions. The alternatives were assigned to numeric values: never (1), rarely (2), sometimes (3), often (4), and always (5). Each of the items for each original domain was coded in the following manner: cognitive domain (items A1, A2, A3, A4, A5, A6, A7, A8), behavioral domain (items B1, B2, B3, B4, B5, B6, B7, B8), affective domain (C1, C2, C3, C4, C5, C6, C7, C8), and physiological domain (D1, D2, D3, D4, D5, D6, D7, D8). For each round of factor analysis, the extraction value for the communalities was taken into consideration. Those items with values of 0.490 and below were discarded for each round. Kaiser-Meyer-Olkin and Bartlett’s tests were also conducted for each round to identify if the data set is eligible for factor analysis. Table 2 presents the results from six (6) rounds of exploratory factor analysis.

**Table 2.** KMO and Bartlett’s tests, discarded items, and number of factors in rounds 1-6 of factor analysis

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Test and Criterion** | **Round 1** | **Round 2** | **Round 3** | **Round 4** | **Round 5** | **Round 6** |
| Kaiser-Meyer-Olkin Test | 0.934 | 0.927 | 0.929 | 0.929 | 0.924 | 0.921 |
| Bartlett’s Test | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| No. of Items with ≥0.5 Extraction Value | 4 | 1 | 1 | 2 | 2 | 2 |
| Discarded Items | A1, A3, A4, B2 | B5 | D5 | B6, D4 | A2, B7 | C1, C6 |
| No. of Factors | 6 | 5 | 5 | 5 | 4 | 4 |

A principal component analysis (PCA) was conducted on the 32 items with orthogonal rotation (varimax). The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO = 0.921 (marvelous, according to Kaiser et al., 1974), and all the communalities extraction values for each item were greater than 0.500, which is well above the acceptable limit of 0.5 (Kaiser et al., 1974). Bartlett’s test of sphericity X2 = 3215.755, p = 0.000, indicated that the correlations between items were sufficiently large for PCA.

With the final value of the KMO test (0.921), the sampling is found to be highly adequate for factor analysis. Bartlett’s test determines if the variables are unrelated and therefore suitable for structure detections such as factor analysis. With Bartlett's test significance level value of 0.000 (obviously less than 0.05) throughout the analysis, it was determined that factor analysis is highly useful in detecting the structures from the data. At the end of the sixth (6th) round of factor analysis, there were 12 items that were discarded in total, leaving a total of 20 items.

**Table 3.** Retained items and their communalities extraction values

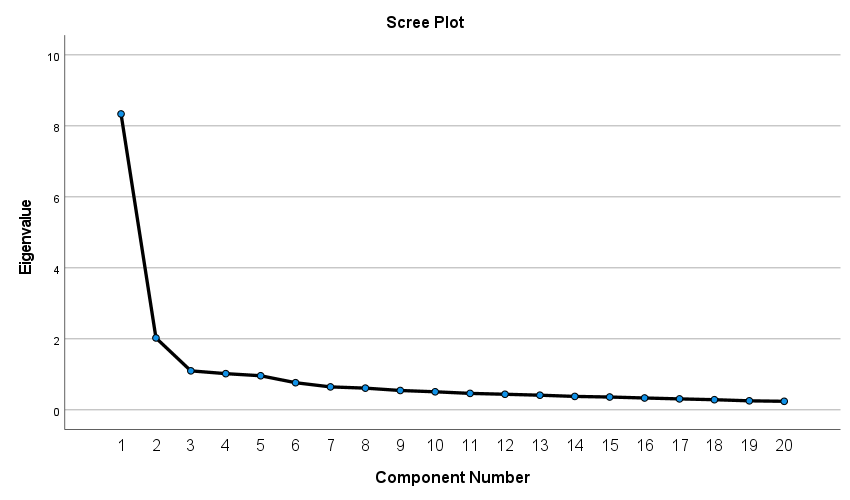
|  |  |  |
| --- | --- | --- |
| **SPSS Code** | **In the past two months, I have been experiencing the following because of our online classes:** | **Communalities**  **Extraction Value** |
| A5 | not thinking enough before I act | 0.684 |
| A6 | not thinking enough before I make decisions | 0.688 |
| A7 | not having a goal in doing things | 0.511 |
| A8 | not realizing the importance of the things I do | 0.596 |
| B1 | lacking appetite or overeating | 0.537 |
| B3 | avoiding my responsibilities more than I used to | 0.613 |
| B4 | delaying my tasks more often than I usually do | 0.654 |
| B8 | difficulty in deciding on what to do first | 0.526 |
| C2 | difficulty in understanding myself | 0.728 |
| C3 | difficulty in identifying my and other people’s emotions | 0.727 |
| C4 | difficulty in talking to people at home | 0.637 |
| C5 | difficulty in getting myself to perform the task that I am required to do | 0.655 |
| C7 | difficulty in managing the task assigned to me in a given period of time | 0.654 |
| C8 | difficulty in studying my lesson with enthusiasm | 0.530 |
| D1 | rapid heartbeat/palpitations | 0.659 |
| D2 | difficulty in breathing | 0.692 |
| D3 | low energy | 0.612 |
| D6 | headaches | 0.626 |
| D7 | difficulty in sleeping | 0.615 |
| D8 | muscle aches and pains | 0.534 |

The six (6) rounds of analysis, while discarding items with extraction values less than or equal to 0.490, were run to obtain the eigenvalues for each of the components of the data. The last round of factor analysis revealed four (4) components that had eigenvalues over Kaiser’s criterion of 1 and in combination explained 62.406% of the variance. Table 4 shows the total variance explained.

**Table 4.** Total variance explained

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Component** | **Initial Eigenvalues** | | | **Extraction of Squared Loadings** | | | **Rotation Sums of Squared loading** | | |
| **Total** | **% of variance** | **Cumulative %** | **Total** | **% of variance** | **Cumulative %** | **Total** | **% of variance** | **Cumulative %** |
| **1** | 8.336 | 41.680 | 41.680 | 8.336 | 41.680 | 41.680 | 3.681 | 18.407 | 18.407 |
| **2** | 2.026 | 10.131 | 51.811 | 2.026 | 10.131 | 51.811 | 3.625 | 18.125 | 36.532 |
| **3** | 1.099 | 5.494 | 57.306 | 1.099 | 5.494 | 57.306 | 2.774 | 13.869 | 50.401 |
| **4** | 1.020 | 5.100 | 62.406 | 1.020 | 5.100 | 62.406 | 2.401 | 12.005 | 62.406 |
| **5** | 0.961 | 4.805 | 67.211 |  |  |  |  |  |  |
| **6** | 0.765 | 3.824 | 71.035 |  |  |  |  |  |  |
| **7** | 0.647 | 3.234 | 74.269 |  |  |  |  |  |  |
| **8** | 0.612 | 3.060 | 77.329 |  |  |  |  |  |  |
| **9** | 0.545 | 2.727 | 80.056 |  |  |  |  |  |  |
| **10** | 0.509 | 2.545 | 82.601 |  |  |  |  |  |  |
| **11** | 0.464 | 2.319 | 84.920 |  |  |  |  |  |  |
| **12** | 0.439 | 2.197 | 87.117 |  |  |  |  |  |  |
| **13** | 0.413 | 2.064 | 89.181 |  |  |  |  |  |  |
| **14** | 0.378 | 1.892 | 91.073 |  |  |  |  |  |  |
| **15** | 0.362 | 1.808 | 92.881 |  |  |  |  |  |  |
| **16** | 0.334 | 1.671 | 94.552 |  |  |  |  |  |  |
| **17** | 0.309 | 1.544 | 96.096 |  |  |  |  |  |  |
| **18** | 0.286 | 1.429 | 97.525 |  |  |  |  |  |  |
| **19** | 0.254 | 1.271 | 98.796 |  |  |  |  |  |  |
| **20** | 0.241 | 1.204 | 100.000 |  |  |  |  |  |  |
| Extraction Method: Principal Component Analysis. | | | | | | | | | |

The scree plot (see Figure 1) showed inflexions that would justify retaining components or factors 1, 2, 3, and 4. Given the large sample size n=319 and the convergence of the scree plot and Kaiser’s criterion on the four components, the four components were retained in the final analysis. Based on the rotated component matrix, Table 5 shows the new clustering of items.



**Figure 1.** Scree plot: eigenvalues versus the component number

**Table 5.** Rotated component matrixa

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Items** | **Component** | | | |
| **1** | **2** | **3** | **4** |
| A5 | 0.146 | 0.176 | 0.773 | 0.187 |
| A6 | 0.059 | 0.066 | 0.808 | 0.166 |
| A7 | 0.049 | 0.392 | 0.562 | 0.197 |
| A8 | 0.116 | 0.362 | 0.666 | 0.085 |
| B1 | 0.643 | 0.301 | 0.095 | 0.157 |
| B3 | 0.318 | 0.596 | 0.395 | 0.024 |
| B4 | 0.070 | 0.690 | 0.416 | 0.017 |
| B8 | 0.277 | 0.605 | 0.163 | 0.238 |
| C2 | 0.403 | 0.212 | 0.195 | 0.695 |
| C3 | 0.104 | 0.171 | 0.202 | 0.804 |
| C4 | 0.340 | 0.245 | 0.152 | 0.662 |
| C5 | 0.206 | 0.571 | 0.275 | 0.459 |
| C7 | 0.138 | 0.691 | 0.224 | 0.328 |
| C8 | 0.252 | 0.565 | 0.243 | 0.297 |
| D1 | 0.769 | -0.020 | 0.159 | 0.204 |
| D2 | 0.785 | -0.010 | 0.215 | 0.170 |
| D3 | 0.567 | 0.435 | 0.192 | 0.253 |
| D6 | 0.624 | 0.471 | -0.018 | 0.123 |
| D7 | 0.528 | 0.504 | -0.054 | 0.284 |
| D8 | 0.659 | 0.307 | -0.021 | 0.078 |
| *Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.* | | | | |
| *a. Rotation converged in 8 iterations.* | | | | |

Based on Table 5, Table 6 presents the new clustering of the group and the items for each of the clusters. Factor 1 is labeled as the domain that concerns Physical Health, factor 2 involves Task Management, factor 3 involves Valuing, and the last one involves Relating to Oneself and Others.

**Table 6.** New clustering or factors of the items

|  |  |  |  |
| --- | --- | --- | --- |
| **Cluster or Factor** | **Factor Labels** | **Code** | **In the past two months, I have been experiencing the following because of our online classes:** |
| 1 | **Physical Health** | B1 | lacking appetite or overeating |
| D1 | rapid heartbeat/palpitations |
| D2 | difficulty in breathing |
| D3 | low energy |
| D6 | headaches |
| D7 | difficulty in sleeping |
| D8 | muscle aches and pains |
| 2 | **Task Management** | B3 | avoiding my responsibilities more than I used to |
| B4 | delaying my tasks more often than I usually do |
| B8 | difficulty in deciding on what to do first |
| C5 | difficulty in getting myself to perform the task that I am required to do |
| C7 | difficulty in managing the task assigned to me in a given period of time |
| C8 | difficulty in studying my lesson with enthusiasm |

|  |  |  |  |
| --- | --- | --- | --- |
| 3 | **Valuing** | A5 | not thinking enough before I act |
| A6 | not thinking enough before I make decisions |
| A7 | not having a goal in doing things |
| A8 | not realizing the importance of the things I do |
| 4 | **Relating to** | C2 | difficulty in understanding myself |
| **Oneself and** | C3 | difficulty in identifying my and other people's emotions |
| **Others** | C4 | difficulty in talking to people at home |

This new clustering makes a lot of sense, as there are items in the original clustering or domains that may overlap in any two or three domains. Given the new factors determined, future research can focus on elaboration and further exploration of each of the factors.

**E. Reliability Test**

The Cronbach’s alpha of the retained 20 items was also determined to know the internal consistency of the items. The values obtained are shown in Table 7. Based on the reliability analysis through SPSS, the Cronbach’s alpha of the data set obtained from the 319 respondents is 0.923. Based on the well-accepted values of the mentioned test, any value greater than 0.90 has an excellent level of internal consistency (Bonett et al., 2014). The Cronbach’s alphas for the new clustering were also determined. Due to the lesser number of items, compared to the overall retained 20 items, the values for each clustering are relatively lower than 0.923. However, they still range within a very good level of internal consistency. According to Taber (2018), when alpha is calculated across several domains, there is a tendency for its value to increase substantially.

**Table 7.** Cronbach’s alpha of the retained 20 items and the new clustering

|  |  |  |
| --- | --- | --- |
| **Clustering** | **Cronbach’s alpha** | **N of items** |
| Retained 20 Items | 0.923 | 20 (B1, D1, D2, D3, D6, D7, D8, B3, B4, B8, C5, C7, C8, A5, A6, A7, A8, C2, C3, C4) |
| Physical Health | 0.864 | 7 (B1, D1, D2, D3, D6, D7, D8) |
| Task Management | 0.864 | 6 (B3, B4, B8, C5, C7, C8) |
| Valuing | 0.791 | 4 (A5, A6, A7, A8) |
| Relating to Oneself and Others | 0.792 | 1. (C2, C3, C4) |

Compared to other instruments, the overall Cronbach’s alpha of the retained 20 items of this particular scale is relatively high. The Perceived Stress Scale (PSS-10) developed by Cohen and Williamson (1988) which is one of the most extensively used instruments in stress research has an alpha of 0.78. Meanwhile, the reliability values of the Educational Stress Scale for Adolescents (ESSA) by Sun et al. (2011) is 0.81, the Perception of Academic Stress Scale (PASS) by Bedewy and Gabriel (2015) is 0.7, and the COVID-19 Student Stress Questionnaire (CSSQ) by Zurlo et al. (2020) is 0.71. All the aforementioned values indicate satisfactory internal consistency. This instrument’s alpha of 0.923 may be the highest among the stress scales, but it does not necessarily mean that it is the most reliable.

There are several factors that could affect an instrument’s reliability. One of which is the number of items. According to Vaske et al. (2016), increasing the number of items will result in a higher alpha value. This instrument’s high alpha could be attributed to the fact that it has the greatest number of items. It has a total of 20 items while the other scales from the oldest to the latest have 10, 16, 18, and 7 items, respectively. Cronbach (1951) cautioned that adding more items that repeat the same information just to increase alpha is pointless.

Another thing to take into consideration when evaluating reliability is the heterogeneity of the research respondents. Those who answered this instrument are adolescents whose age ranges from 11 to 17, but who study in the same private high school. Meanwhile, university students who are 18 to 26 years old are the primary respondents of the CSSQ and the PASS with each study involving 514 and 100 participants, respectively. The PSS-10 was originally responded to by a total of 2,387 adults from various socio-economic backgrounds and the ESSA by 1,670 students aged 12 to 18 living in urban and rural settings. Based on the said data, the respondents of the PSS-10 and the ESSA are the most diverse. Producing consistent results regardless of the diversity of the participants is a good indicator of an instrument’s reliability.

It is important to note that the stress scale administered to the participants of this study and the CSSQ are somewhat similar in terms of context. Both instruments were developed during the online learning setup because of the COVID-19 outbreak. The rest of the scales were made pre-pandemic.

**F. Invariance tests**

Measurement invariance tests were conducted for the identified factors, namely, Physical Health, Task Management, Valuing, and Relating to Oneself and Others across (a) sex, (b) grade level, and (d) age. Table 8 presents the results of measurement invariance fit indices. The general CFA model (G) confirms a good fit of the scale’s measurement model with SRMR and RMSEA within the threshold level of acceptance. Results of measurement invariance tests establish structurally and construct validity of the newly developed four-factor stress scale in the context of online learning. The results also allow examination of the difference among groups.

*Invariance for sex*

Male (M) and female (F) CFA measurement models yielded a good fit with SRMR value lower than the cut-off. In terms of RMSEA, however, M model showed good fit while F model had slightly higher than the cut-off, though the lower bound of CI was still within the threshold. Results of measurement invariance fit indices revealed acceptance level up to strict factorial invariance with almost all figures fell within the threshold levels, except that of chi-square difference with significant p-value. According to Putnick & Bornstein (2016), some researchers have changed from a focus on absolute fit indices because chi-square is quite sensitive to small, unimportant deviations from “perfect” model in large samples. Thus, results of alternative fit indices still hold, proving that there is a measurement invariance across sexes. Findings of measurement invariance imply that the newly developed four-factor stress scale in the context of online learning measures the same underlying constructs across sexes, i.e., male and female, allowing us to examine group differences.

*Invariance for grade level*

The CFA measurement models of Grade 7 (G7), Grade 8 (G8), Grade 9 (G9), and Grade 10 (G10) yielded good fit with at least one fit index fell within the threshold of acceptance. G7 CFA models had RMSEA good fit while G8, G9, and G10 had SRMR good fit. Results of measurement invariance fit indices revealed acceptance level up to strict factorial invariance with almost all figures fell within the threshold levels, except that of chi-square difference with significant p-value. Findings of measurement invariance tests suggest that newly developed four-factor stress scale in the context of online learning measure the same underlying constructs across group levels, allowing us to examine group differences.

*Invariance for age*

The CFA measurement models for almost all age groups (A2, A3, and A4), except A1 yielded at least one good fit index. However, A1 (11-12) only had lower bound of CI that fell within the threshold level. Results of measurement invariance fit indices revealed acceptance level up to strict factorial invariance with all figures fell within the threshold levels. Findings of measurement invariance tests indicate that the newly developed four-factor stress scale in the context of online learning measure the same underlying constructs across age groups, allowing us to examine group differences.

**Table 8.** Measurement invariance model comparison across sexes, grade levels, and age groups for CFA Four-factor Model of the Stress Scale in the Context of Online Learning

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Model | x2 (df) | SRMR | RMSEA  (90% CI) | Model comp. | Chi-Square difference  (df difference) | Change in SRMR | Change in RMSEA | Decision |
| **General** (n = 319) | G | 411.79 (164) | .057 | .078  (.069; .086) | - | - |  |  | - |
| **Sex** |  |  |  |  |  |  |  |  |  |
| Male (n = 151) | M | 263.26 (164) | .064 | .066  (.051; .081) | - | - |  |  | - |
| Female (n = 168) | F | 365.96 (164) | .067 | .091  (.079; .104) | - | - |  |  | - |
| Configural | Csex | 631.08  (328) | .062 | .080  (.071; .090) | - | - |  |  | - |
| Metric | Mesex | 642.05  (344) | .068 | .078  (.068; .087) | Csex | 9.05  (16) | .006 | .002 | Accept |
| Scalar | Scsex | 696.23  (360) | .073 | .080  (.071; .089) | Mesex | 56.38\*\*\*  (16) | .005 | .002 | Accept |
| Strict factorial | Stsex | 724.23  (380) | .075 | .079  (.070; .088) | Scsex | 27.87  (20) | .002 | .001 | Accept |
| **Grade level** |  |  |  |  |  |  |  |  |  |
| Grade 7 (n = 73) | G7 | 258.48  (164) | .090 | .087  (.065; .108) | - | - | - | - | - |
| Grade 8 (n = 86) | G8 | 297.41  (164) | .076 | .099  (.081; .117) | - | - | - | - | - |
| Grade 9 (n = 83) | G9 | 301.94  (164) | .081 | .104  (.085; .122) | - | - | - | - | - |
| Grade 10 (n = 77) | G10 | 302.98  (164) | .077 | .108  (.089; .127) | - | - | - | - | - |
| Configural | Cgrade | 1157.13  (656) | .077 | .100  (.091; .110) | - | - | - | - | - |
| Metric | Megrade | 1213 .97  (704) | .093 | .097  (.088; .106) | Cgrade | 55.44  (48) | .016 | .003 | Accept |
| Scalar | Scgrade | 1284.50  (752) | .096 | .096  (.087; .105) | Megrade | 69.91\*  (48) | .003 | .001 | Accept |
| Strict factorial | Stgrade | 1334.16  (812) | .097 | .090  (.083; .100) | Scgrade | 51.38 | .001 | .004 | Accept |
| **Age** |  |  |  |  |  |  |  |  |  |
| 11-12 (n = 59) | A1 | 253.47  (164) | .098 | .095  (.071; .118) | - | - |  |  | - |
| 13-14 (n = 143) | A2 | 289.35  (164) | .066 | .077  (.062; .091) | - | - |  |  | - |
| 15-17 (n = 117) | A3 | 321.64  (164) | .072 | .096  (.080; .112) | - | - |  |  | - |
| Configural | Cage | 869.02  (492) | .071 | .088  (.078; .097) | - | - |  |  | - |
| Metric | Meage | 904.98  (524) | .081 | .085  (.076; .095) | Cage | 34.73  (32) | .01 | .003 | Accept |
| Scalar | Scage | 948.96  (556) | .083 | .084  (.075; .093) | Meage | 43.14  (32) | .002 | .001 | Accept |
| Strict factorial | Stage | 982.74  (596) | .084 | .081  (.072; .089) | Scage | 34.28  (40) | .001 | .003 | Accept |

*Note:* \*p < .05 \*\*p < .01 \*\*\*p < .001; CFI = Comparative Fit Index; SRMR = Standardized Root Mean Square Residual; RMSEA = Root Mean Square Error of Approximation; CI = Confidence Interval; Model comp. = Model comparison; decision = accept or reject measurement invariance

**G. Differences in stress levels between male and female, grade levels, and age brackets**

The conducted measurement invariance tests indicate that the scale measures the same underlying constructs across sex, grade level, and age groups. This finding allowed the researchers to also identify if there are significant differences between the stress levels of certain groups. Independent-samples t-test was conducted to compare the stress levels between junior high school male and female students in the context of online learning, as shown in Table 9. It was found out that with enough evidence (at α = 0.05) there is no significant difference in the stress level index between males (M=2.6182, SD= 0.74939) and females [M=2.9640, SD=0.80971; t(317)=0.757, p=0.385].

**Table 9.** Stress levels between male and female students in the context of online learning

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Descriptive Statistics** | | |  | **t-Test Results** | | | | | |
| Sex | Mean | SD | N |  | t | df | p | Mean Diff | 95% of CI of the Mean Difference | |
|  |  |  |  |  |  |  |  |  | Lower | Upper |
| Male | 2.6182 | 0.74939 | 151 |  | 0.757 | 317 | 0.385 | 0.0542 | -0.5182 | -0.1733 |
| Female | 2.9640 | 0.80971 | 168 |  |  |  |  |  |  |  |

One-way Analysis of Variance (ANOVA) was conducted to compare the stress levels between junior high school Grades 7, 8, 9, and 10, as shown in Table 10. It was found out that with enough evidence (at α = 0.05) there are no significant differences in the stress levels among students in Grade 7 (M=2.7301, SD=0.77364), Grade 8 (M=2.7826, SD=0.84365), Grade 9 (M=2.7898, SD=0.74013), and Grade 10 (M=2.8981, SD=0.83974); F(3, 315)=0.588, p=0.623].

**Table 10.** Stress levels among Grades 7-10 students in the context of online learning

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Grade Level** | **Mean** | **SD** | **N** |  | **df between**  **group** | **df**  **within group** | **F** | **p** |
|  |  |  |  |  |  |  |  |  |
| 7 | 2.7301 | 0.77364 | 73 |  | 3 | 315 | 0.588 | 0.623 |
| 8 | 2.7826 | 0.84365 | 86 |  |  |  |  |  |
| 9 | 2.7898 | 0.74013 | 83 |  |  |  |  |  |
| 10 | 2.8981 | 0.83974 | 77 |  |  |  |  |  |
| Total | 2.8003 | 0.79944 | 319 |  |  |  |  |  |

Also, a one-way Analysis of Variance (ANOVA) was conducted to compare the stress levels among junior high school students by age brackets (11-12, 13-14, and 15-17), as shown in Table 11. It was found out that with enough evidence (at α = 0.05) there are no significant differences in the stress level index among ages 11–12 (M=2.7288, SD=.75614), ages 13–14 (M=2.7514, SD=.83183), and ages 15–17 (M=2.8962, SD=.77738); F(2, 316)= 1.347, p=0.261].

**Table 11.** Stress levels of students in age brackets 11–12, 13–14, and 15–17

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Age Brackets** | **Mean** | **SD** | **N** |  | **df**  **between group** | **df**  **within group** | **F** | **p** |
|  |  |  |  |  |  |  |  |  |
| 11-12 | 2.7288 | 0.75614 | 59 |  | 2 | 316 | 1.347 | 0.261 |
| 13-14 | 2.7514 | 0.83183 | 143 |  |  |  |  |  |
| 15-17 | 2.8962 | 0.77738 | 117 |  |  |  |  |  |
| Total | 2.8003 | 0.79944 | 319 |  |  |  |  |  |

To summarize, the test with enough evidence was able to prove that there are no significant differences in the stress level among the following groupings: sex (male and female), grade level (7, 8, 9, and 10), and age brackets (11-12, 13-14, and 15-17).

1. **CONCLUSION AND RECOMMENDATIONS**

This study aimed to develop an instrument that can quantify the stress levels of students, specifically junior high school students in an online setup. From the original 32 items (divided equally among the four domains: (1) cognitive, (2) behavioral, (3) affective, and physiological), 20 items were retained after conducting factor analysis. A new clustering was also derived from the results, namely: (1) physical health, (2) task management, (3) valuing, and (4) relating to oneself and others. The final 20-item questionnaire was proven to give reliable data having the Cronbach’s alpha of 0.923. Measurement invariance for each group (sex, grade level, and age) was also determined. Findings indicate that the newly developed four-factor stress scale in the context of online learning measure the same underlying constructs across the three groups mentioned. Consequently, the differences in stress levels among the groups were also determined. With enough evidence, it was proven that there are no significant differences in the stress level among the following groupings: sex (male and female), grade level (7, 8, 9, and 10), and age brackets (11-12, 13-14, and 15-17).

The results, more specifically those that are regarding the new clustering, imply that these clusters of factors (physical health, task management, valuing, and relating to oneself and others) can be the starting points of the interventions that schools, teachers, and even the parents can provide. It is easy to assume that a group of people is experiencing certain stress levels and the interventions can be hit-or-miss. With these factors, which will be strengthened further by future studies, interventions will be more contextualized, specifically toward online learning of junior high school students. The results of this study also imply that the usual categorization or domains of stress levels such as cognitive, behavioral, affective, and physiological do not stand as umbrella domains in certain cases such as online learning. This can be because of the overlapping experiences of the effects of the stress that a person may experience in this new setup. Like any other study, this research can serve as the foundation of future studies. One possible research direction is focusing on one of the clusters or factors identified. Another is giving the same questionnaire to a larger group of respondents. Future researchers may also contextualize the survey for a more advanced group of learners such as those in senior high school, college, and graduate school.

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